

# **The digital divide: Trends in global mobile and broadband Internet access from 2000-2010**

**Charlene Ronquillo, RN, MSN<sup>1</sup>, Leanne Currie, RN, DNSc<sup>2</sup>**

**<sup>1</sup>Vancouver, BC, Canada; <sup>2</sup>University of British Columbia, Vancouver, BC, Canada**

## **Abstract**

*The digital divide is described as the gap between those who do and do not have access to digital information and communications technologies (ICT). ICTs are viewed as an indicator of infrastructure and potential for development, and are a growing platform for health information and services delivery. This study compares the penetration of mobile and broadband Internet technologies by global region from 2000 to 2010. Results illustrate the rapid growth of mobile cellular telephone subscriptions in all global regions with trends suggesting a continued increase. Little to modest gains were made in fixed broadband Internet subscriptions globally. There is a growing popularity of mobile subscriptions with use of data communications, exceeding the numbers of fixed Internet subscriptions. This comparison reveals current strengths that can be built on and highlights the importance of awareness of global trends and using such knowledge to inform design and delivery of ICT-based health services.*

## **Introduction**

The disparities in access of digital information and communications technologies (ICT) has come to be referred to as the “digital divide” between those who have access to ICT and those who do not.<sup>1-3</sup> Although there is yet to be definitive consensus on the extent, impact, or causes of the digital divide, the literature identifies numerous contributing factors including low socioeconomic status, race and ethnicity, and living in rural settings, among others.<sup>1,3</sup> Notable differences in access to ICT are observed within developed nations between different socioeconomic groups, and there is strong indication that economic factors are one of the most important determinants of ICT access.<sup>4</sup> Not surprisingly, inequities in access to ICT become clearly evident when looking at the digital divide on a global scale. For example, about one half of the population uses the Internet in North America, while in South Asia and Sub-Saharan Africa, Internet users account for about 0.5% of the population.<sup>5</sup>

The United Nations Millennium Development Goals recognize ICT as an indicator of a nation’s infrastructure and an important medium for information delivery and education.<sup>6</sup> ICT additionally have important implications on health outcomes in terms of healthcare professionals’ exposure to and capacity for exchange and management of health information.<sup>7</sup> Just as important is the ability for ICT to serve as a bridge to connect health professionals with each other on a local and global scale. For example, remote clinics have the potential to be linked to larger local hospitals, national centres of excellence, international specialists and international scientists. Another important potential is the ability to take advantage of existing ICT infrastructure for the delivery of health information and health services, particularly to underserved and vulnerable populations that may additionally have numerous geographic and economic barriers. The recent decade has seen the number of promising health applications and services delivered over digital platforms continue to grow. A number of these provide more cost-effective alternatives to current interventions. To locate the increasing potential of ICT within the context of the global digital divide, this study examines the trends in ICT access or penetration per global region from the years 2000 to 2010. Specifically, it examines mobile and broadband Internet penetration from a global lens.

## **Mobile cellular telephone and broadband Internet: Global trends**

The purpose of this study was to examine and compare the trends in international broadband Internet and mobile cellular telephone penetration to provide an illustration of the digital divide from a global lens. The importance of broadband Internet, with regard to increasing capacity for connectivity and access to information, is well-recognized. Broadband Internet is viewed as an indicator of infrastructure and as a potential medium for delivery of promising applications and services in information and communications delivered over broadband.<sup>8</sup> However, it is important to consider that broadband Internet access remains relatively exclusive to well-developed countries and populations with the financial means to afford computers and broadband Internet subscriptions. It is reasonable to assume that the capacity to support broadband Internet access for the general population in less developed nations will lag substantially. Lower levels of literacy, health literacy, and computer literacy in these nations compounds the problem, which translates into lengthy delays and often severe limitations in such nations’ access to and ability to benefit from broadband Internet.

The potential for technologies that deliver information and health services based on mobile cellular telephones should be acknowledged, particularly given the substantial growth of mobile phone usage in recent decades. This growth is especially important in poorer nations.<sup>6</sup> Recent years have seen the growing potential of mobile phone technology for use in health information access and delivery for healthcare in general. Mobile health (mHealth) services use technologies designed for and delivered via hand-held or other portable technologies and is an emerging modality for the delivery of health information and services.<sup>9</sup> mHealth will likely remain a valuable tool given the further reaching mobile cellular penetration in regions where infrastructure for broadband Internet access has yet to substantially develop.

## Methods

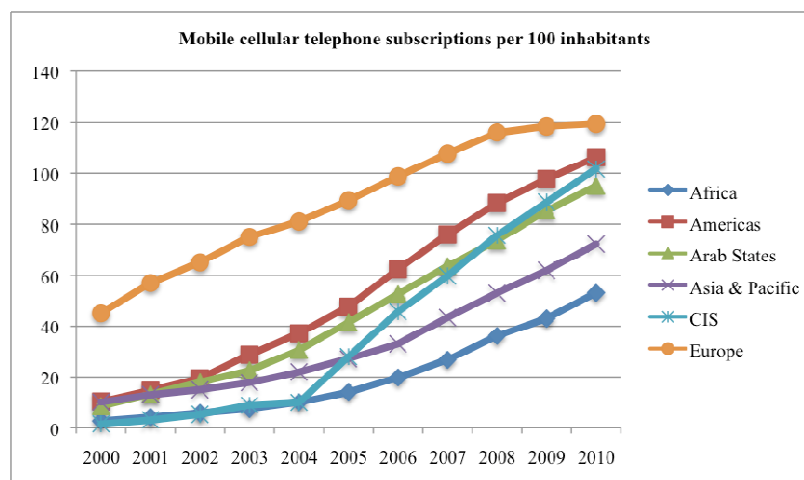
In this study we analyzed data from the International Telecommunications Union's (ITU) 15th Edition of the World Telecommunication/ICT Indicators Database.<sup>10</sup> The database was purchased and downloaded directly from the ITU Website (<http://www.itu.int/ITU-D/ict/definitions/regions/index.html>). The ICT Indicators Database contains time series data annually from 1975 to 2010, around 100 ICT statistics (e.g. ICT uptake, mobile services, tariffs, revenues, etc.), and data for over 200 economies. The ICT Indicators Database includes software that generates reports in a spreadsheet format that can then be exported to external statistical software.

This analysis examines the trends in ICT penetration from 2000 to 2010. Four indicators which are identified according to the ICT Indicators Database codes were used: (1) Mobile cellular telephone subscriptions per 100 inhabitants (post paid + prepaid); (2) Fixed (wired) broadband Internet subscriptions per 100 inhabitants; (3) Terrestrial mobile wireless subscriptions per 100 inhabitants; and (4) Standard mobile subscriptions with use of data communications at broadband speeds per 100 inhabitants. Indicator 3 is the sum of active mobile broadband subscriptions and dedicated mobile data subscriptions. Indicator 4 is subset of indicator 3 and we have chosen to analyze this separately in order to capture all mobile subscriptions that can reach broadband speeds, regardless of whether it is via a dedicated data subscription or not. Regions included in the analysis are: Africa, the Americas, the Arab States, Asia & the Pacific, the Commonwealth of Independent States (CIS), and Europe. For the purpose of this study, the regions and countries included within each region are those determined by ITU classifications.

Using the ICT Indicators Database software, reports were produced for each region. Countries within each region were entered individually along with all four indicators, and each year from 2000 to 2010, to produce each regional report. The report spreadsheets were exported to Microsoft Excel descriptive statistics were run. Average values are calculated for each region each year.

## Results

Mobile cellular subscriptions increased internationally from 2000 to 2010 (See Figure 1). The CIS, (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan), saw the greatest growth. In 2000 this region had the lowest number of subscriptions across regions, but by 2010 the region had one of the highest numbers of subscriptions per 100 inhabitants. The Americas and Arab States had a similarly ample growth with an average increase of 91.1 mobile subscriptions per 100 inhabitants.



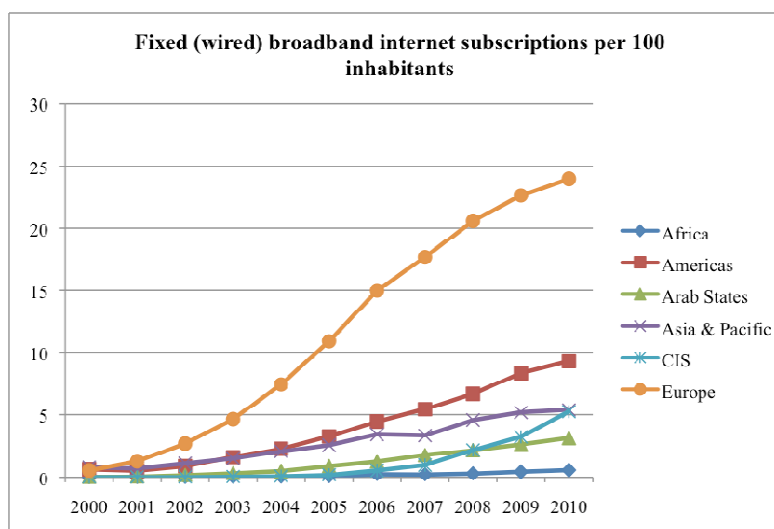
**Figure 1.** Mobile cellular telephone subscriptions per 100 inhabitants

Modest growth was seen in Europe with an average increase of 74.3 subscriptions at the end of the decade. The regions with the lowest growth were Africa and Asia & Pacific with an increase of about 56.1 more subscriptions in 2010 than in 2000. (See Table 1 for detailed data). Overall, by 2010 the lowest penetration for mobile cellular subscriptions was 53% in Africa, followed by 72% in Asia and the Pacific. Europe, the America and the CIS had subscription rates higher than 100, indicating that some individuals had more than one subscription.

**Table 1.** Mobile cellular telephone subscriptions per 100 inhabitants from 2000-2010

Region	Year										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Africa	2.84	4.30	5.89	7.53	10.13	14.07	19.81	26.79	36.20	42.99	53.08
Americas	10.43	14.77	19.53	28.77	37.17	47.64	62.34	75.95	88.27	97.71	106.2
Arab States	8.61	13.24	18.04	22.55	30.59	41.45	52.58	63.53	73.61	85.32	95.03
Asia & Pacific	10.19	13.08	15.08	17.82	21.99	27.17	33.04	43.35	52.99	61.83	72.16
CIS	1.63	3.18	5.40	8.99	16.05	28.01	45.68	59.69	75.62	88.65	101.7
Europe	45.10	56.91	65.01	75.02	81.08	89.30	98.71	107.7	115.9	118.4	119.4

Globally, fixed broadband Internet subscriptions substantially lagged behind mobile subscriptions (See Figure 2). The highest number of subscriptions was seen in Europe with an increase of 23.4 subscriptions per 100 inhabitants between 2000 and 2010 (from 0.53 to 23.97). All other regions saw fairly slow growth over the decade. By 2010 subscriptions ranged from 0.56 in Africa to 8.69 in the Americas and an average growth of 4.45 subscriptions among all regions excluding Europe (See Table 2).



**Figure 2.** Fixed (wired) broadband Internet subscriptions per 100 inhabitants from 2000-2010

**Table 2.** Fixed (wired) broadband Internet subscriptions per 100 inhabitants from 2000-2010

Region	Year										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Africa	0.00	0.00	0.00	0.01	0.03	0.06	0.23	0.21	0.28	0.43	0.56
Americas	0.62	0.51	0.87	1.60	2.26	3.26	4.45	5.45	6.68	8.36	9.31
Arab States	0.01	0.04	0.15	0.30	0.48	0.87	1.24	1.76	2.15	2.62	3.13
Asia & Pacific	0.78	0.69	1.09	1.49	2.06	2.56	3.41	3.33	4.57	5.19	5.39
CIS	0.00	0.00	0.00	0.03	0.07	0.17	0.53	0.96	2.16	3.23	5.26
Europe	0.53	1.26	2.68	4.64	7.45	10.92	14.98	17.68	20.58	22.64	23.97

No data were available for standard mobile subscriptions with data communications at broadband speeds from 2000 to 2006. Data between 2007 and 2010 were inconsistent. However, for countries in which data were reported for more than one year, there was an overall increase in the uptake of standard mobile subscriptions (data not shown).

The terrestrial mobile wireless subscription indicator similarly contained limited data. No values were available for any region from 2000-2006 and only Africa and Asia & Pacific had data for each year from 2007 to 2010, but these were only from a few countries in each region. As with standard mobile subscriptions with data, there was a general increase in uptake reported for countries that had more than one year of data (data not shown).

## **Discussion**

This study examined the trends in mobile cellular telephone, fixed broadband, and wireless broadband penetration from 2000 to 2010 in six global regions. In calculating the average number of subscriptions per 100 inhabitants for each, we found that mobile cellular telephone subscriptions had the most substantial growth in all regions compared to all other indicators, reflecting expected trends and correspond with findings in the literature. There is a divide in trends of fixed wireless broadband subscriptions with Europe being clear leader and remaining regions lagging behind. Notably, Africa has less than 1 subscription per 100 persons, illustrating clearly that there are significant barriers for broadband Internet penetration within this region and is reflective of what is known in the literature.

The changes over time are interesting as they provide a sense not only of the rate of penetration within each region, but also allows for comparison of penetration between different types of ICT within each region. The penetration of mobile cellular telephone subscriptions is by far the most rapidly increasing globally and the trends suggest that this will likely continue. It is interesting to note that for countries that provided data, standard mobile subscriptions with data has increased faster than fixed broadband Internet subscriptions. This result is particularly reflective of the determinants of the digital divide discussed in the literature. Specifically, this “leapfrogging” of mobile broadband penetration over wired broadband penetration can likely be explained by the difference in financial, infrastructure, and ICT literacy requirements when comparing computer-based broadband Internet access versus mobile phone with Internet access with broadband speeds.

These rates of penetration highlight important technologies that can be “taken advantage of”. For example, the rapid and continued growth of mobile cellular access serves as a potential to use this technology for public health information sharing (e.g. nationwide announcements of epidemics) and delivery of interventions (e.g. monitoring of chronic conditions via text “check ups”). The leapfrogging of mobile broadband over fixed broadband as illustrated in these data in some ways justify the increasing mhealth efforts that concentrate on mobile cellular technologies with broadband capabilities (i.e. smart phones). It is important, however, to be mindful that the ease of information sharing via fixed or mobile broadband internet in regions with more developed ICT infrastructures is not the reality for most regions. The drive towards developing “faster and better” web programs and applications, and the heavy dependency on the web as the sole repository of information, then needs to be reconsidered. Simply, efforts in mhealth should not be driven by novelty alone, but take into consideration user needs and access.

These data suggest that there may be an even greater potential to focus on mobile cellular technologies (without broadband data access) given its rapid and continued penetration among regions. When data are examined at the country level, further within-region differences in mobile cellular penetration are apparent, particularly in Africa. This suggests that although mobile cellular telephones have the greatest penetration on a global level, further growth at the country levels have yet to develop. Therefore, to truly view ICT penetration from a global health lens, it is arguable that there may be more to gain by focusing efforts in mhealth on mobile cellular technologies. Although in comparison, it is easy to see the far greater capacity and potentials of mobile broadband technologies, focusing solely on these may neglect the larger global population who may better benefit from the exploration of mobile cellular technology potential.

In illustrating the changes in ICT penetration globally over the recent decade, these data also highlight important potential sources of information that can be used to inform development and growth of ICT infrastructure in poorer regions and countries. For example, these data clearly illustrate the rapid growth of mobile cellular technology CIS region. Within the decade, mobile cellular penetration has risen in this region from being the lowest to being one of the highest. Some important questions to then ask are, “What has happened in this region to facilitate this change? And how can we use this knowledge to inform growth and development of ICT in other regions?”

## Conclusion

Compared globally, there is a sense of being constantly connected in the Western world and arguably, there may be a tendency to take for granted that Internet access at high speeds is commonplace and available to most people. We know that this is not the case and need to remain mindful that for the majority of the world, this type of access lies in the very distant future. As ICT technologies develop in regions with lower rates of penetration, it may also be useful to look to those regions that have experienced rapid growth in penetration to gain insight as to what lessons can be learned in ICT infrastructure development. If our aim is to close the gap of the digital divide and establish ICT as an important medium for health information and health care delivery, we need to be aware of current trends in ICT penetration in order to tailor our efforts appropriately. For example, the findings that mobile cellular telephone subscriptions have been rapidly increasing across all regions and mobile subscriptions with data is increasing faster than fixed broadband Internet connections should inform the design and delivery of ICT-based health services. It may be that currently, mobile telephone and mobile data communication-based technologies should be further explored as fixed Internet infrastructures continue to develop. In short, we must be mindful of the capacities of the target populations and regions in order to better the chances of having effective outcomes.

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